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Original contribution

# Can we use lower volume of local anesthetic for infraclavicular brachial plexus nerve block under ultrasound guidance in children?

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ABSTRACT

*Objectives:* To determine if the infraclavicular brachial plexus block can be applied with lower volume of local anesthetic.
*Design:* Randomised, double-blinded clinical trial.
*Patients:* 60 patients aged 5–15 years with ASA I–II who underwent emergent or elective arm, forearm or hand operations were included in the study.
*Interventions:* Patients were divided into two groups randomly; standard volume local anesthetic administered group (Group S, n = 30) and low volume anesthetic administered group (Group L, n = 30).
*Measurement:* Postoperative pain scores, sensory and motor block durations were noted.
*Main results:* Pain scores (Wong-Baker Face Scale) were evaluated and the results were detected to be similar at all times (30 min, 1, 2, 4, 8, 12, 24 h). Durations of motor block were 168(±16) minutes and 268(±15) minutes in Group L and Group S respectively and the difference was statistically significant ($p < 0.001$). Durations of sensory block were 385(±26) and 402(±39) in Group L and Group S respectively and no statistically significant difference was detected ($p = 0.064$).
*Conclusion:* Similar block success, postoperative sensory block durations and pain scores could be obtained during infraclavicular brachial plexus in pediatric patients with lower local anesthetic volumes.


## 1. Introduction

Brachial plexus block is a well-defined technique for upper extremity surgery. Brachial plexus block in pediatric patients was first published by Small [1]. Interscalene, supraclavicular, axillary and infraclavicular approaches are defined for brachial plexus. However, interscalene and supraclavicular approaches are not recommended for pediatric patients due to possible complications (vertebral artery puncture, cervical nerve block, phrenic nerve block, Horner syndrome, pneumothorax) [2].

Axillary block is frequently preferred in pediatric patients as it is safe for possible complications; however, the position maintained during nerve block being painful and inefficient analgesia of the arm are disadvantages of axillary block [3]. Infraclavicular nerve block in pediatric patients is defined both with nerve stimulator [4] and ultrasound (US) guidance [5]. Coracoid process could be used as a landmark in case neurostimulator is used for brachial plexus with infraclavicular approach. However, muscle contractions due to neurostimulation will be painful especially in cases with fractures [5].

US plays an important role in recognition of nerves during regional anesthesia applications [6]. It provides the chance of visualization of nerves directly and distribution of local anesthetics.

In addition, US allows reposition of the needle in cases in which local anesthetic distribution is not as desired and helps to avoid complications [7]. Safe US use in adults is mentioned in published papers. Regional anesthesia in pediatric patients is being increasingly used and these interventions are performed under sedation or general anesthesia. Therefore, US guidance has an important potential for pediatric anesthesia [5].

Local anesthetic toxicity should be considered as high volumes of local anesthetics are used for peripheral nerve blocks. US guidance could be helpful to apply lower volume of local anesthetics as it provides visualization of brachial plexus nerve roots and distribution of applied local anesthetic [8]. In this study, we aimed to investigate effects of lower volume local anesthetic application for infraclavicular brachial plexus nerve blocks during arm, forearm and hand operation in pediatric patients on motor block duration, sensory block duration and postoperative 24 h analgesia quality. According to our researches in

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medical literature, we concluded that this study is the first local anesthetic volume study about infraclavicular brachial plexus block performed on pediatric patients.

## 2. Materials and methods

60 children (ASA I–II, 5-15 years old) who underwent emergent or elective arm/forearm or hand operations were included in the study after approval of University Ethical Committee. Informed consents were obtained from parents of the patients and patients were separated into two groups randomly. Patients were included into two groups using a computer-generated randomization. The group that was administered 0.25 ml/kg local anesthetic volume was named as low volume group (Group L), and the one that was administered 0.5 ml/kg was named standard volume group (Group S). Patients who had respiratory, cardiac, hepatic, renal problems, neurologic deficits on the side of the operation, skin infection around the operation site, coagulopathy and those who did not accept the operation were excluded from the study.

Patients were monitored with ECG, non-invasive blood pressure and pulse oximeter during operation. Venous access was performed on the non-operated extremity after application of EMLA crème (Astra Zeneca, Wedel, Germany) and than 2–3 mg/kg 1% propofol (Propofol %1, Fresenius Kabi, Istanbul, Turkey) was administered and laryngeal mask (LMA Supreme™) was placed. Anesthesia was maintained by administration of 50%$N_2O$:$O_2$, sevoflurane (Sevorane, Abbott Lab, North Chicago, ABD) 2–3% in first 15 min and $N_2O$ was stopped after 15 min when block was done. 50% air/$O_2$, 2–3% sevoflurane were administered while maintain spontaneous respiration. Afterwards, infraclavicular brachial plexus nerve block with US (EsoateMyLab™30Gold, Genova, Italy) guidance was performed to patients who had spontaneous respiration. All patients were examined for pneumothorax after the infraclavicular block.

Infraclavicular blocks were performed by the same anesthesiologist who has been experienced for US guided block in both Group L and Group S. Head of the patient was turned towards the opposite direction of the side of operation after LMA was placed while patient was in supine position (Fig. 1A). The arm which will be blocked was placed in adduction and the forearm was located on abdomen. Site of the block was sterilized. US probe (EsoateMyLab™30Gold linear probe, 10–18 MHz, Genova, Italy) was prepared under sterile conditions and brachial plexus cords (anterior, posterior, medial) were visualized in infraclavicular area around axillary artery (Fig. 1B) Local anesthetic was administered after negative aspiration observation between posterior cord and axillary artery under US visualization (in-plain technique was used) of 22G, 50 mm block needle (Stimuplex Ultra, B Braun Medical) and U shaped distribution of local anesthetic around axillary artery was observed (Fig. 1C). Needle was repositioned if needed according to local anesthetic distribution. Bupivacaine 0.5% and lidocaine 2% mixture (1:1) containing 1/200,000 adrenaline in volumes of 0.25 ml/kg and 0.5 ml/kg were administered to the patients.

N2O was stopped after 15 min following block and anesthesia was maintained by 50% air/oxygen mixture until the end of operation. Hemodynamic parameters were recorded. 2 μg/kg fentanyl (Talinat 0.5 mg/10 ml, VEM Ilac, Ankara, Turkey) was administered if heart rate of the patient was raised above 10% of basal and the respiration rate was raised above 20% of basal. Intraoperative opioid need of the patients was recorded. Possible complications such as pneumothorax, neurologic morbidity, hematoma and Horner's syndrome were noted. Also, Patients were called for follow-up visits 1 week after block was performed and presence of neurologic problems due to nerve damage was evaluated by an anesthesiologist.

Motor block duration was defined as the time until visualization of finger abduction after brachial plexus block. Sensory block duration was defined as the time passed between brachial plexus block and first rescue analgesic administration. Times of disappearance of motor and sensory blocks were also recorded.

In recovery room, postoperative pain experienced by patients was evaluated with Wong Baker Face Scale (Fig. 2). 10 mg/kg of i.v. paracetamol (Parol iv flacon, Atabay Kimya, Istanbul, Turkey) was administered to the patients every 6 h starting right after surgery postoperatively. Patients who had pain score >3 were administered 7.5 mg/kg oral ibuprofen (Ibufen 100 mg/5 ml, Abbott Labs, Istanbul, Turkey) as rescue analgesic.

### 2.1. Statistical analysis

The sample size required for the study was calculated based on the duration of sensory block time benefit between the groups. According to Russ Lenth's Piface Java module, we determined that the number of patients required in each group was 30, based on a power of 82% and alpha error of 0.05 with a 34% difference in duration of sensory block time. IBM SPSS 20.0 (SPSS Inc., Chicago, Illinois, USA) software program was used to perform the statistical analysis. The distribution of the variables was evaluated for normality using the Kolmogorov-Smirnov and histogram tests. Descriptive statistics was expressed as the means ± standard deviation (SD). Categorical variables were analyzed using the chi-square test. The normally distributed data comprising continuous variables were analyzed using Student's *t*-test. Otherwise, the Mann–Whitney *U* test was used. A value of $p < 0.05$ was considered statistically significant.

## 3. Results

Eligible patients for this study were presented in a Consolidated Standards of Reporting Trials (CONSORT) flow diagram (Fig. 3). Demographic and operation-related data are shown in Table 1. No statistically significant difference was detected between the two groups related to

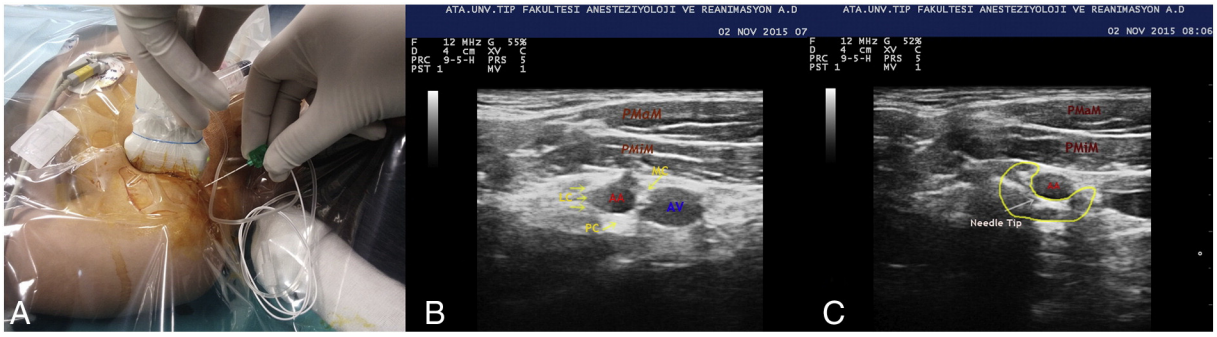


**Fig. 1.** A) Patient position, B) infraclavicular area around axillary artery, C) yellow-framed area shows spread of local anesthetic around axillary artery, AA: axillary artery, AV: axillary vein, LC; lateral cord, PC: posterior cord, MC: medial cord, PMaM: pectoralis major muscle, PMiM: pectoralis minor muscle. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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